ART. VIII.—*Health and Disease as influenced by the Daily, Seasonal, and other Cyclical Changes in the Human System.* By EDWARD SMITH, M.D., LL. B., F. R. S., Assistant Physician to the Hospital of Consumption and Diseases of the Chest, Brompton; Physician to the Dramatic College; Corresponding Member of the Académie des Sciences, Montpelier, and of the Natural History Society of Montreal. London: Walton & Maberly, 1861. 8vo. pp. 409.

Health: its Friends and its Foes. By R. D. MUSSEY, M. D., LL. D., late Professor of Anatomy and Surgery at Dartmouth College, N. H., and of Surgery in the Medical College of Ohio; Fellow of the American Academy of Arts and Sciences, etc. etc. Boston: Gould & Lincoln, 1862. 8vo. pp. 368.

THE valuable and suggestive work of Dr. Smith particularly commends itself to the student of biology. It has been written, as we learn from the preface, "with a view to supply a deficiency which exists in medical literature, and to offer the results of a series of inquiries in aid of our knowledge on the two functions of the medical practitioner—the preservation of health and the treatment of disease." These inquiries have been made by the author upon himself and others, both in health and disease, and have been prosecuted almost without intermission through a period of six years.

A work in which are described the cyclical changes occurring in the human system, and the influence exerted by season in reference to the causation and treatment of disease, cannot fail, if properly executed, to be a most important addition to the literature, not only of physiology, but also of practical medicine.

Very little reflection is needed to show that an inquiry at once more important and complex than this can scarcely be found in the whole range of medical and physical science.

The complexity of such an investigation arises from several causes, and in proportion to its complexity is the uncertainty that must, for the present at least, attend its practical and beneficial applications. But the importance of these applications is equal if not paramount to the difficulties which beset the whole study, inasmuch as they are among the most prominent of those hygienic means to which the physician philosophically resorts in order to prevent disease rather than to attempt its cure by the employment of certain isolated and empirical formulæ.

In the great problem, to the solution of which Dr. Smith has devoted himself with such praiseworthy zeal, several factors are given, each in a state of activity at the same time, to determine their relation. These factors are the healthy cyclical changes occurring in the body of man, the cause and treatment of, and the mortality from, disease on the one hand, and certain constant atmospheric changes, &c., on the other. If all or either one of these factors were simple, the investigation would be very much simplified, and consequently rendered far more certain in its results. But unfortunately for the student they are compound; each one being made up of a number of associated elements.

Take, for example, the mortality from disease. Instead of being simple, this is in reality a compound element. A dozen cases of a certain disease —scarlatina for instance—may die from as many different causes. The specific malignancy of the malady falling upon and poisoning the nervous centres may produce death, during the initiatory fever, either by convulsions or coma. Or the fatal termination may be caused by a phlegmasial attack, either of the brain, lungs, or some of the abdominal viscera. The deathward path, for some of the patients, may lie through general debility, whether superinduced by depressed or lessened vitality, or by some wasting, purulent discharge. Finally, some of the cases may die from the peculiar renal dropsy of this exantheme. Now it is within the experience of every observant physician that the climatic condition which would hasten death by one of these modes, would retard it in another. Hence, if we content ourselves with merely recording the mortality from scarlet fever, during a given time, without reference to the immediate cause of death, in one column, and opposite to it, in another column, the thermometric, barometric, hygrometric, and other conditions of the atmosphere for the same time, we must necessarily be led into error, or, at least, arrive at results so restricted and uncertain in character, as to be of but little use. This is one source of fallacy, which, as far as we can find, is invariably overlooked.

Again, the mortality from disease is complicated by another series of conditions, whose positive value yet remains to be established, viz., age, sex, height, weight, habits, modes of living, &c. This statement also applies to the cause of disease, and to the normal or healthy course of life in man.

The climatic conditions which influence the body of man in health and disease are numerous, and, within certain limits, constantly varying in combination and intensity. Necessarily, therefore, their influence is a fluctuating one. As these conditions or elements of climate—light, heat, electricity, moisture, atmospheric pressure, &c.—are always associated, it is very difficult to arrive at even an approximate estimate of the power of each one, or even of the exact relation which each one bears to the other in that series.

The science of climatology is of very recent growth. Indeed, the men who have given to the study its scientific character belong to the present day. Humboldt, in the admirable researches upon the causes of the inflections of the isothermal lines, recorded in his *Asie Centrale;* Dove, by his inquiries into the laws of the rotation of the winds; Boussingault, in his *Economie Rurale;* Kæmtz and others have all contributed largely towards reducing to a few systematic and comprehensive generalizations the mass of statistics which have been so rapidly accumulating during the past few years. But notwithstanding the extensive and laborious observations of many of these eminent physicists, so much that is still in doubt remains to be generalized and reduced to simple expressions or laws, that we must still regard as true the remark long ago made by Mason Good: "Of all the subdivisions of general philosophy," said this writer, "there is none so little entitled to the name of science as meteorology."

That the innumerable facts and details of disease have not yet been reduced to their fewest and simplest expressions, none who are at all conversant with theoretical and practical medicine will deny. Never will there be created a philosophy of pathology—we use this term in its most comprehensive sense—a philosophy in whose domains will be found the solution of such great questions as the unity or specific diversity of disease, the relation of constitutional and local disease, &c., until the numerous and ever varying phenomena of the healthy organism are reduced to a regular and well defined system, in which the relation, power, influence, and cyclical variations of each and every functional act are clearly understood.

From the tenor of these remarks it must be manifest that the satisfactory study of any one of the many questions that are involved in medicine and climatology must be very difficult, in consequence of the numerous and variously associated elements which enter into and complicate these questions. Unable as we are to assign a true and positive value to each of these elements individually, simply because we cannot isolate them, how much more difficult must appear the attempt to demonstrate the relations of the two groups—the attempt to explain a series of protean and ill-understood phenomena by another with which we are no better acquainted—in short, to explain the complicated phenomena of normal and aberrant vitality by the equally complicated phenomena of climate.

Calling to his aid experiment and observation, Dr. Smith, in the treatise under notice, addresses himself to the accomplishment of this task with marked ability.

The first chapter of his work contains an interesting account of the daily fluctuations in the rate of the pulse and the functional activity of the lungs and the kidneys, during the use of ordinary food and during fasting. The method employed in the prosecution of the scientific researches here recorded, and the important results obtained, should be carefully studied by the medical practitioner. After noticing briefly the well-known investigations of Kiell, Robinson, Falconer, Quetelet, Knox, Guy, and others upon the pulse, our author says:—

> "These varied and numerous inquiries have afforded much information, but were deficient in that they did not in any case embrace the whole cycle of the twenty-four hours, and were not made under conditions so precisely parallel that they could be advantageously compared with each other, and hence it was desirable to make such a new series of observations as by their duration, the number of persons under observation, the uniformity in the conditions of the inquiry, and the extreme regularity in the period and mode of making the observations, should afford complete cycles and conditions which should render the results entitled to credit. To this end two sets of inquiries were set on foot, one in reference to health, and the other in cases of phthisis, the former embracing hourly observations on five persons, including children, and extending over three days and nights; and the latter on six adults of both sexes, extending over six days and nights without intermission. The general conditions imposed were precision in the hours of meals and of rising and retiring to rest, absolute rest during at least five minutes before each inquiry, and rigid attention to the hour, to the order of the cases, and to the method of counting and registering the rate of the functions. The posture selected was that of lying, since that alone was possible during sleep, and it is important to bear in mind that a considerable addition to that rate must be made if we would ascertain the rate in the sitting and the standing postures; but for the purpose of showing the progressive changes throughout the day either of the postures uniformly maintained is of nearly equal value. The true effect of posture and its variations during the day was determined by a third series of inquiries, in which the rate in each posture was determined at four periods of the day in several persons in health, and at 8 A.M. and 4 P.M. in fifteen phthisical persons during the space of a month."

Following the method of research above indicated our author has arrived at certain conclusions which are strikingly exhibited in a series of tables and diagrams. From these we learn that the rate of both pulsation and respiration was increased during the day and decreased during the night, that these changes did not occur abruptly, but that there was a period of increase in the morning and of decrease in the evening; that the amount of depression in the rate of the pulse in relation to the greatest elevation varied in different persons, but not in any definite relation to age, for whilst in the elder of two children examined the greatest rate was $\frac{1}{2.9}$ more than the least rate, in the younger it was $\frac{1}{4.6}$; whilst in adults it was $\frac{1}{4.1}$ and $\frac{1}{4.5}$; and in the author himself $\frac{1}{5.8}$; that in reference to the rate of respiration there was a progressive decrease in this proportion as age advanced, the increase of the maximum over the mininum being in the order of age; that the variations in the rate of the pulse were greater during the day than in the night, in the former three or four marked elevations alternating with an equal number of depressions; that the periods of lowest pulsation during the day were commonly 8 A. M. and midday; and that the average increase per minute in the rate of respiration was, after breakfast 4.4, dinner 2.1, and tea 2.1, and of pulsation 15, 12, and 6, in the same order. Dr. Smith also found that the increase in the rate of respiration at breakfast was sometimes more than $\frac{1}{3}$, but it was less than that amount at dinner. Sometimes at both dinner and tea no increase was observed. During the act of eating an increase took place which disappeared in the intervals of the courses. This temporary increase was often as high as from twelve to fifteen pulsations per minute. The greatest increase observed in adults was twenty-three pulsations per minute, though the effect of eating was much less pronounced in them than in children.

The general course of the daily cycle of pulsation and respiration is thus summed up by our author:—

> "In the evening, from 7 to 9 P. M., there is an evident tendency in the rate to decline, and with some slight variations this is continued progressively through the following hours until from 1 to 3 A. M., when the rate is at its minimum. During the next two hours there is a slight tendency to increase, but it is very gradual until the usual hour of rising, when it will have attained an increase of several pulsations per minute. Immediately after the breakfast has been taken there is a rapid and great increase, which attains its maximum in the second hour afterwards, after which it declines greatly in an hour, and loses from ten to fifteen pulsations immediately before the dinner. After the dinner has been taken there is another increase, but the rate is seldom raised so high as that which follows the breakfast, and the highest point is attained in the second or third hour. This again is followed by a decrease which precedes, and a subsequent increase which follows the tea, when a point as high as that which follows the breakfast is usually found; and lastly, there is the final decrease, which is usually progressive, notwithstanding that supper may be taken at a later hour. When dinner had been taken at a later hour than that above indicated, the rate of the functions followed the same course as that now given, except that there was not any important increase after mid-day until the dinner hour. The rate remained low, but not uniform, from 12 to 1 P. M. until the dinner hour.
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> "The extreme difference was sometimes thirty pulsations per minute, and was the greatest in the children.
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> "The ratio of the two functions varied with each hour of the day, but was the highest during the day, and the lowest during the night.
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> "The ratio is dependent rather upon respiration than pulsation, so that the high ratio of the day is due to the fact that whilst the rate of both functions is then increased, that of respiration is increased disproportionately. The extremes were as 1 to 2.9 and as 1 to 5.7, or the larger was double the smaller ratio; but there was no ratio nor any progression of ratios which was absolutely uniform on consecutive days.
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> "The effect of posture is very different in different persons and at various times, both of the same and different days, so that averages give but a very imperfect view of the result." * * * An inquiry was made upon four persons on three successive days in October, at 8 A. M., mid-day, 5 P. M., and 8 P. M.
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> "In both the children (examined) the effect was much greater at 8 P. M. than at any of the other periods, and particularly the effect of the standing posture, whilst in the adults the converse was observed. In one of the children the

increase before the dinner and the supper was much greater than that before the other meals, whilst in the elder child the effect of the standing posture was the least before the dinner, and that of the sitting posture the least before the breakfast. The younger of the two adults was affected by posture to a greater extent than even the children, and at the same time the results were far more uniform than those obtained from the latter. The progression in the decrease as the day advanced was very striking in that case. Thus the increase in the sitting posture was 12, 9, 7.3, 3.5, and in the standing posture 27, 14.6, 12, 10 pulsations per minute as the day advanced. The increasing effect upon the rate of respiration in the children in the evening was quite as great as upon pulsation, whilst the decreasing effect was equally well marked in the respiration of the younger adult, in whom, indeed, the effect of posture upon the rate of that function was then almost entirely lost."

In phthisical patients Dr. Smith discovered the same progression in the phenomena of pulsation and respiration as that recorded above for healthy persons, but the extremes are much greater. The total rate of the functions, he informs us, was higher, the difference between the rate in the day and the night was much greater, and oftentimes more than forty pulsations per minute, and consequently an increase of thirty-five to forty pulsations per minute was commonly found after breakfast. In women the rate was observed to be more uniform, and the depression of the night was greater than in men.

"Hence, in reference to pulsation the only remarkable difference between health and phthisis is the extreme variation in the latter of the night and the day rate, with, as a consequence, the signal increase in the morning and the decrease in the evening; but in reference to respiration, the singular fact was noticed in most of the cases, that the rate increased in the night in a most evident manner, and fell in the morning on waking, so much sometimes as twelve to fifteen respirations per minute. On the whole average of the women, the increase in the number of respirations was nearly seven per minute from 10 P. M. to 11 P. M., when they fell asleep, and that there was an average, though a less increase, until 6 or 7 A. M. The average increase in the men was 1.7 per minute from 10 P. M. to 11 P. M., and four per minute at midnight, from which hour the increase gradually subsided."

The next series of inquiries to which our author directs attention were undertaken to determine the hourly variations in the amount of carbonic acid expired and the quantity of air inspired.

Investigations of this character have been made and recorded by Coathupe, Prout, Scharling, Vierordt, and others. The results arrived at by these experimentalists are too well known to the physiological reader to need any reference here. Coathupe and Prout sought the percentage amount only of carbonic acid in a few cubic inches of expired air. Vierordt noted the hour of his observations, but did not undertake to determine the variations from hour to hour. Dr. Smith instituted an extended series of inquiries upon four gentlemen, aged severally 26, 33, 39, and 48 years, during the 18 hours of the working day, and upon himself in the hours of the night. In two sets of these experiments the quantity of carbonic acid was collected during ten minutes at the commencement of each hour, and also of each half hour following the meals; whilst in two others, the whole carbonic acid evolved was collected without intermission, except during a few minutes when food was taken. In the two former, the experiments were uniformly made in the sitting posture, but in the latter the sitting or the standing posture was adopted at indicated periods.

In conducting these experiments our author's method was to collect all the carbonic acid evolved from the lungs by breathing over a solution of caustic potass which occupied the floor of several chambers of a box of gutta percha, and offered so extensive a surface that the whole of the carbonic acid was absorbed during the act of expiration. A detailed description of the apparatus employed would occupy too much of our space; we must, therefore, refer our readers for it, and the illustrative figures accompanying it, to the work itself.

The results obtained by Dr. Smith in this field of his inquiry are thus recorded in his own language:—

> "In experiments made to determine the amount (of carbonic acid) evolved under the influence of not very profound sleep, it was found to be 4.88 grains and 4.99 grains per minute, at 1 and 3 A. M.; but we estimated the amount at 4½ grains per minute in profound sleep. Hence, commencing at from 1 to 3 A. M., the period when the lowest amount of carbonic acid is evolved (4.88 and 4.99 grains with sleep, and 5.7 and 5.94 grains when scarcely awake), it was found that there was an increase at about 6 A. M., when it amounted to a little more than 6 grains per minute, and at 7 A. M., after rising, to 7 grains per minute. The effect of the breakfast was to cause a total increase of 2½ to 3 grains per minute, in from one to two hours, followed by a decrease of 1 to 1½ grains per minute before the dinner. There was commonly an increase after dinner of about 1 grain per minute, and usually a decrease from that period to the hour of taking tea; but on some occasions, as on March 12, the quantity remained high until after the tea had been taken. After tea there was again an increase of from 1 to 1½ grains per minute, and the highest point of the day was attained. At about 7 o'clock a fall began to occur, and the decline progressed to the extent of 2 or 3 grains per miute at the hour of bedtime, but sometimes after supper, the quantity remained somewhat elevated until a later hour. After retiring to rest, at 11 o'clock, the quantity fell steadily until 1 to 3 A. M., when the minimum was attained.
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> "Hence there were commonly 4 minima and 3 maxima in the daily quantities of carbonic acid evolved, the former found immediately before each meal (except supper) and during the night, and the latter following each meal. The largest increase commonly followed breakfast and tea, and then the total quantities evolved were nearly identical, whilst there was also a great similarity in the minimum quantities recorded at the end of the intervals between the meals. This variation was due to food, but there was a low point below which the quantity did not fall. The highest amount of this variation was from one-third to one-fourth of the whole quantity evolved. There was not any hour of the day in which the evolution of carbonic acid was stationary, except in the hours immediately preceding the breakfast."

With regard to the quantity of air inspired, Dr. Smith found that there was a general concurrence in the progression of the quantities both of the carbonic acid expired and the air inspired. In himself, and three other persons, he discovered that the proportion of the carbonic acid to the quantity of air inspired at rest was 1 grain to 58 cubic inches; 54.8 cubic inches; 58.5 cubic inches; and 54.7 cubic inches respectively.

From the foregoing statements it will be seen that, in the cycle of the day and night, the phenomena of the pulse, respiration, inspiration of atmospheric air, and the evolution of carbonic acid, exhibit a remarkable uniformity in their fluctuations, and in the manner in which they are influenced by food and the digestive act. To complete the picture of this physiological cycle, an inquiry into the amount of urea discharged from hour to hour during the day is required. To this inquiry we find that our author has also addressed himself with the effect of arriving at some novel conclusions.

Finding that no reliable experiments had been attempted to determine the hourly variations in the urea and urine, he commenced a series of inquiries upon himself in the beginning of 1860, and continued them on nearly every day until March, 1861, with a view to show the variations of urea and urine, hour by hour, under noted conditions. This resulted in the determination of the total quantities of the twenty-four hours of the day and night, separately, of the quantity secreted before breakfast, after the night urine had been passed, of the quantities to twelve mid-day, and during each two hours in the afternoon, and, lastly, of the quantity evolved at each quarter of an hour after the breakfast and an early dinner on different days. At the same time the fluid and solid egesta were duly determined.

After mentioning that the least quantity of urea discharged per hour was through the night and immediately before breakfast, Dr. Smith says:—

> "Immediately after breakfast, consisting of one pint of coffee, with bacon and bread, there was a most rapid increase, so that between 9 and 12 A.M., the quantity increased from 10 or 15 grains to 25 or 30 grains per hour, and from 12 to about 2 o'clock, the greatest amount of the day was evolved. At 4 or 6 P.M., the quantity had declined 5 to 10 grains per hour, and the decline commonly continued progressively until the night minimum was attained, but sometimes the quantity remained high until late in the evening. Hence the greatest amount of urea evolved per hour is in the early part of the day, and as the day advances the amount declines, whilst the lowest amount of the 24 hours occurs during the night hours. The maximum period of the day is about, or soon after mid-day, and the ascent and descent in the quantity are very rapid. A second increase occurred at 6 to 8 P.M.
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> "In these experiments it is important to bear in mind that the breakfast was a good one, and was followed by a moderate and simple dinner, without wine, at about 2 P.M., 14 oz. of tea at 5 or 6 P.M., and 15 oz. coffee, each with bread and butter, at 9 or 10 P.M. Hence, it was evident that the larger evolution of urea neither corresponded with the amount of nitrogenous matter taken in the previous meal, nor with the exertion made, but rather with the degree of activity of the vital processes. When, however, an unusually large or unusually late dinner was taken, with more than an ordinary quantity of wine, the proportionate amount of night urea was considerably increased, and the increase was carried on to the following day.
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> "When the food and fluid are fairly distributed over the day, as is the case with the masses of the people in all countries, there can be no doubt that the largest hourly excretion of urea occurs before 2 P.M., and thence forward there is a slow but not uniform diminution to the minimum of the night. * * *
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> "The quantity of urea evolved in each ounce of urine varies with the quantity of water evolved, and diagram No. 6 shows that the quantity per ounce is the inverse of the quantity per hour. Thus, in the morning hours, with sudden and great increase of the urea per hour, there is a great decrease of that substance per ounce, and as the day advances, the quantity per ounce increases as the quantity per hour decreases. The opposition of the two sets of curves is most striking, and it not uncommonly occurs that the hour of highest elimination of urine is that of the smallest quantity of urea per ounce. * * * * * *
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> "The quantity of water evolved per hour is the least during the night, and commonly there is a small increase before the breakfast in the morning. After breakfast there is a rapid increase, so that from 1½ ounce per hour at 8½ A.M., there will be 4 or 6 ounces per hour at 10½ A.M., and 6 to 8 ounces per hour at mid-day. From about this period there is a decrease, so that at 4 P.M. the quantity is reduced to 4 ounces per hour, at 7 or 8 P.M. to 2 or 3 ounces per hour, at 11 P.M. to less than 2 ounces, and from that point it falls to the lowest period of the twenty-four hours. It is, however, highly probable that if only a small quantity of fluid were taken at the usual breakfast hour, the excessive elimination of water before mid-day would not occur, and a more uniform distribution over the middle hours of the day would result. But when a large amount of fluid is taken at night, it commonly happens that no corresponding increase in the quantity of urine occurs on that day, but the fluid is retained, and is emitted on the following day."

The remaining pages of the first chapter of Dr. Smith's work are devoted to a detailed account of the results of an experimental inquiry into the influence of fasting upon the daily progression of the pulse, respiration, exhalation of carbonic acid and watery vapour from the lungs, and the elimination of urea and urinary water.

In the second chapter, which is well worthy of careful study, an admirable attempt is made to utilize these results of scientific research by pointing out their applications to practical medicine. Indeed, the work under consideration may be regarded in its entirety as a contribution to the science of *applied* physiology. In turning over its pages we feel at a loss which to commend the more, the purely scientific investigations therein recorded, or the manner in which the author, playing the part of the true physician, the healer and conservator of health, indicates how the results of these investigations may be most usefully employed as guides in the treatment and prevention of disease.

The practical truths inculcated in this chapter are laid down in a series of aphorisms, each of which is explained and commented upon at greater or less length. These aphorisms or rules applicable to health and disease are as follow:—

"1. In the morning hours, digestion and assimilation are performed in their most natural, and, therefore, most healthful manner, and that period especially demands an abundant supply of nutriment.

"2. No one in health complains of having taken too much breakfast.

"3. After the mid-day meal the amount of nutriment supplied should be more limited.

"4. With too much food supplied in the latter part of the day, there is a natural desire for artificial foods, or foods of a more highly seasoned kind, and for alcohols, and at that period such substances exert less influence upon the organism than they would exert in the morning.

"5. Early retiring to rest is indicated.

"6. Food should be taken in the night only under exceptional circumstances."

Dr. Smith's experiments show that the morning is the period of greatest vital action, and that as the day advances the food taken at the different meals does not cause an equal increase in the rate of the functions, the amount of urea being usually lessened hour by hour. Such facts seem to point out the necessity for a substantial breakfast, or one in which the amount of nutriment is of more importance than the quantity of food taken. The drinking of large quantities of tea and coffee at breakfast would appear, therefore, to be far less advantageous than the consumption of solid nutriment. These infusions contain but little nutritious matter, and as stimulators of the assimilative functions, they are less needed in the early part of the day, when these functions are naturally active. According to our author, milk, oatmeal and bread, and eggs, or other solid materials, should be freely used at breakfast. As tea is opposed to nutrition, it should not be used at this time, except when the natural powers of the system are insufficient to produce healthy assimilation. Food should be taken in the morning before any large amount of labour is performed, for with labour there is increased waste, and before breakfast there is no supply. An abundant and an early breakfast is especially essential to children, inasmuch as the increase in the vital actions in the early morning is greater in them than in adults. The rate of pulsation and respiration, and the evolution of carbonic acid being the greatest in one or two hours after breakfast, and again reduced at about four to five hours after that meal, to the lowest point to which it falls in the working day, an early and nutritious dinner is required. This meal should be followed in the evening by a light supper. At this period of the day no substantial food should be taken, except under peculiar circumstances. For the observations of Dr. Smith show that after the middle hours of the day, the results of the chemico-vital action within the system are lessened, and that in the advanced evening they progressively and rapidly diminish, whatever may be the amount of nutriment supplied. Hence the activity of the assimilative function being lessened in the after part of the day, there is less necessity for the transformation of food, the introduction of which, at this time, to any extent, is more likely to be productive of injurious, rather than of beneficial results. According to our author, the object which should be had in view in the evening is rather the more complete transformation of the food which has been already taken than the supply of a further amount of food, and hence such respiratory and alimentary excitants as tea and coffee are clearly called for. In cases of great exhaustion, as in phthisis, in young infants, and in persons subjected to night-watching, with or without muscular exertion, food should be taken during the night.

The next series of aphorisms relates to variations in the quantity of blood and the heat of the body.

"7. The largest quantity of blood is found within two hours after each meal.

"8. The period of the day when there is the greatest amount of blood is usually in the afternoon, but it depends much upon the period of meals, and the amount and kind of fluid and food taken.

"9. The dangers resulting from excess of blood occur chiefly in the evening, and increase after each meal.

"10. The dangers from defect of blood occur mostly in the middle and advanced hours of the night, also in prolonged intervals between meals, and after unusual emissions of fluids.

"11. The dangers, whether from excess or defect of blood, are materially modified by change of posture of the body.

"12. It is believed to be well established that the normal temperature of the body is nearly uniform, and varies but two or three degrees under whatever normal conditions the body may be placed.

"13. This variation results from changes in the development and distribution of heat.

"14. The dangers from excess of heat are the greatest at and after the middle of the day.

"15. The dangers from defect of heat occur in the night and in the early morning.

"16. The arrangements in reference to the clothing of the body tend to lessen the variations of the heat of the body.

"17. Excessive clothing at night is highly injurious."

With regard to the capability for bodily and mental exertion, our author deems himself warranted by his observations to lay down as practical guides the following regulations:—

"18. The period most fitted for bodily labour is from the breakfast until the evening.

"19. The night is unfitted for physical labour.

"20. The periods most suited for mental labour are the morning and evening."

Next in order come certain generalizations relating to periods of the attacks of disease and the administration of remedies.

"21. In states of debility there is the greatest exhaustion in the evening and in the early morning.

"22. In conditions of mal-assimilation of food it is important to apply all suitable remedies during the middle periods of the day.

"23. Fevers and similar diseases, having an increase in the evening, require a modification of the natural arrangement.

"24. In acute inflammation the remedies should be chiefly employed in the middle parts of the day.

"25. Apoplexy chiefly occurs after a meal, or in the later hours of the day.

"26. Hemorrhage is much more liable to occur in the day than in the night.

"27. The remedies for the states of exhaustion, as the delirium of inanition or delirium tremens, should be applied chiefly in the evening and during the night.

"28. Nervous affections are commonly the most marked in the evening and during the night.

"29. The period for the administration of medicines should vary with the known mode of action of each medicine, and the hourly variations in the vital processes of the system.

"30. Purgatives should be always administered at night, for then there is the greatest accumulation of blood, and of carbonaceous or other effete alvine matter.

"31. Diuretics should be administered with considerable frequency in the afternoon and evening, and not in the morning.

"32. Sudorifics are called for in the daytime, and directly after each meal, so long as any excess of food shall be found in the system. They are less indicated in the night, and in the early morning they would be injurious.

"33. Stimulants, when required at all, are especially needful in the early morning and in the evening, whilst during the day they may be much less advantageous.

"34. Sedatives, when intended to influence the whole economy, are suited to control excess of action during the day, and may then be more freely administered than during the natural period of decline of the vital powers in the advanced evening.

"35. Narcotics, having a mixed action, are rather suited to the class of cases where there is unusual depression of the vital powers, and then may be used temporarily at any time, but for a continued action they are more suitably administered in the late evening, since they primarily excite, and by repetition may be restricted to that action.

"36. Cholagogues are more called for in the afternoon and night when the transformation of food is more urgently required."

We regret that our limits will not permit us to dwell at any length upon the facts adduced and the reasoning adopted by our author in support of the foregoing propositions. We recommend their perusal to our readers with the assurance of deriving profit therefrom.

Chapter 3d treats of the weekly cycle performed by the vital operations. Having established the occurrence of a daily cycle of vital changes, each returning with regularity as the phenomena of the day appear, and each bearing a close resemblance to those which have come before, Dr. Smith next attempts, but with less success, we think, to demonstrate the weekly fluctuations in the rate of pulsation and respiration, in the evolution of carbonic acid and urea, and in the weight of the body. A weekly cycle of vital changes is not so evident, inasmuch as the causes of recurrence are not universal, and do not so readily attract attention. With most persons this weekly cycle appears to be influenced, if, indeed, it is not produced, by the institution of the Sabbath—the long-ordained day of rest to the mental and physical organization. In the course of his inquiries at the Hospital of Consumption, Dr. Smith found that the rate of pulsation increased through the week and decreased on each Monday, whilst that of respiration decreased through the week and rose on Monday. An increase in the quantity of carbonic acid evolved was commonly observed on Monday morning. This increase probably resulted from an unusual accumulation of nutritive matter, caused by rest, and a little increase in the quantity of food taken on Sunday. There was commonly an increased elimination of urea on Sunday, including the day and the following night. In the whole average of the year, to the end of February, 1861, the amount of urea evolved daily was seventeen grains more on Sunday than on week-days, the actual quantities being 523 grains daily on the whole average, and 540 grains daily on the average of the Sundays. The weight of the body is highest on Sunday; as the week advances it is lessened, until on Saturday it reaches its lowest point. From these statements our author infers that a periodical day of rest is necessary to the well-being of the body if a suitable amount of exertion be made daily; and that clergymen and others whose duty calls them to labour on Sunday should set apart another day as a day of rest.

From the early part of 1858 to the beginning of 1861 Dr. Smith was engaged, as he informs us, in studying the influence of seasonal changes upon the evolution of carbonic acid, the quantity of air inspired, the depth of inspiration, the rate of pulsation and respiration, and the elimination of urea, water, and other excretions. These scientific researches and the practical applications deducible from them are embodied in chapters 4, 5, and 6 of the work under consideration. They may be thus summed up:—

In the early part of June the amount of carbonic acid evolved began to diminish, and continued from that to decrease progressively through June, July, and August, until the commencement of September, when the lowest point was attained. From this time an upward tendency was manifested, and it continued through October, November, and December, until January, when a point was reached from which there was little variation through January, February, and March. In April and May the amount was yet further increased until the starting-point was again reached. The extreme amount of change observed was a loss of 3 grains of carbonic acid per minute (or one-third of the maximum quantity) from the beginning of June to that of September; a gain of 2 grains and upwards from September to January; and a further gain of half a grain to the maximum period of the year. The average amount of carbonic acid for the whole year, given out at rest and before breakfast, was a little over 8 grains per minute.

> "From the whole of the foregoing statement we learn that in the summer season the amount of chemico-vital change progressively lessens, until the period arrives when there has been the greatest accumulation of heat upon the surface of the earth; in the autumn there is a progressive increase, by which two-thirds is gained of that which had been lost in the summer months; in the winter the amount is tolerably stationary, and varies scarcely more than half a grain per minute, whilst in the spring there is the highest amount of vital action observed during the whole cycle of the year."

The average amount of air inspired was 425 cubic inches per minute, the extremes being 588 cubic inches, observed on April 12th, and 363 cubic inches on July 13th. From April to October the quantity decreased: after October it increased. The monthly average rate of respiration was 14.3 per minute in April; from this point it declined to 10.9 per minute in August, September, October, and November; thenceforward the rate increased again, but fell short of the number recorded in the previous April. The rate of pulsation continued high during the summer months, and attained its average maximum of 73.3 per minute in August.

The daily quantity of urea eliminated in 1860 was found by Dr. Smith to increase steadily from March to September, except in the month of July, when it fell somewhat. During October, November, and December, the quantity was diminished. In January, February, and March, 1861, it again increased. From May to October the average daily amount discharged was 570 grains; from November to April, 480 grains. It thus appears that under ordinary conditions there is a progressive increase in the excretion of urea as the spring advances, and throughout the summer, until the autumnal months, when the amount corresponds very much with that evolved during the winter. The quantity of urinary water discharged per day during 1860, increased from March to September, when the maximum was attained, and an average increase of 13½ ounces per day was recorded. From this time there was a progressive decrease, with a minimum in the month of January, when the decrease from the maximum was 17 ounces per day.

In concluding the account of this series of his researches our author presents us with the following

"*Summary of Seasonal Influences.*

"*Summer.*—The summer season exerts the most marked power, and under its influence the body exhibits the following minimum and maximum conditions:—

"There is the *minimum* of carbonic acid and vapour exhaled, of air inspired, of the rate and force of respiration, of alimentation and assimilation, of animal heat generated, of muscular tone and endurance of fatigue, and, in general, of resistance to adverse influence.

"There is the *maximum* of the rate of pulsation, of the action of the skin, and the elimination of vapour; of the dispersion of heat, of the supply of heat from without, and of excess of heat; of the elimination of urea and urinary water; of the distribution of blood to the surface, of the imbibition of fluids, of relaxation of the tissues, and of poverty and carbonization of the blood.

"*Winter.*—In the winter season the above conditions are, for the most part, reversed.

"*Autumn.*—Autumn is marked by the summer or the winter condition, as the character of the season resembles the one or the other; but it is essentially a period of change from the minimum towards the maximum of vital conditions.

"*Spring.*—In the early and middle parts of the spring season every function of the body is in its highest degree of efficiency, but as it advances these maximum conditions merge into those of summer."

Advancing still further into the work under notice, we find that the next eighty pages, constituting chapter 6th, are devoted to a deeply interesting discussion as to the influence of season upon muscular power, sensibility, viability, growth, food, disease, and medical treatment. Our author herein displays the true Hippocratic spirit of observation. He advances, as the matured results of his inquiries, and as he has already done in one of the previous chapters noticed above, a series of physiological and hygienic aphorisms, in support of the truthfulness and reliability of which he brings forward reasons of a more or less cogent nature. Many of these aphorisms may be accepted by the practitioner as well-established and truthful guides. The correctness of some of them, however, we are constrained to think is still open to discussion. Be this as it may, we deem them all of sufficient importance to be reproduced here, especially as their recital is necessary to complete the analysis which we desire to present to our readers.

"1. The muscular force and power of endurance of the body varies with the season, and the least is found at the end of summer or the beginning of autumn.

"2. The causes of the diminution in power and endurance are four, viz.: The rapidity of the circulation, the difficulty of maintaining a fixed temperature, lessened chemical action, and relaxation of tissue.

"3. Spring is the season of greatest muscular power and endurance, and then the winter.

"4. The sensibility of the system to temperature and tactile impressions is greatest in the spring and summer.

"5. The viability of those children is the greatest who are born in the winter and spring months, and the most suitable periods for marriage are the spring and summer months.

"6. The periods of maximum and minimum growth are spring and summer, on the one hand, and autumn and winter on the other.

"7. There is less variation in the amount and kind of food taken by mankind than has been asserted.

"8. The dangers from excess of refuse food are greater in the summer than in the winter.

"9. Free dejection from the bowels is more necessary in summer than in winter.

"10. Free emission of urea is the most necessary in spring and summer.

"11. Spring is the season the most fraught with danger from excess of transformation of food.

"12. It is probable that nitrogenous foods are more necessary in the hot season than we at present admit.

"13. The use of diluents is nearly equally necessary at all seasons of the year, but for very different purposes. In winter diluents are especially needed to enable the urea to be freely evolved. In the summer season they are chiefly required to supply a sufficient amount of fluid for the purposes of the perspiration.

"14. The amount of blood is probably the greatest in the spring, and the least at the end of summer.

"15. The Turkish bath may be beneficial in spring and summer, and at the change of the seasons, but can only be useful in conditions of the system in which there has been an undue retention of fluids, or in which the skin is deficient in activity.

"16. The foundation of seasonal disease is the varying degree of vital action proceeding within the body at the different seasons of the year.

"17. There are diseases which result from an arrest or lessening of the natural tendencies of the system.

"18. The constitutional peculiarities of individuals modify the effects of season.

"19. The dangers to be apprehended in the progress of disease vary with the season. The dangers will increase as the season progresses, and will be greatest at the commencement of the period of change.

"20. The frequency of certain diseases has a relation to the season, and to the nature of the disease.

"21. Diseases of the alimentary canal have their maximum intensity and frequency at the period of minimum vitality.

"22. The greatest mortality from the plague in England occurred at the minimum period of vitality.

"23. The greatest mortality in chest diseases is found in the periods of increasing and maximum vital action, and the least mortality at those of minimum vital action.

"24. Brain diseases prevail in the cold season.

"25. Eruptive diseases for the most part prevail at the seasons of change.

"26. The type of a disease has also reference to the conditions of the system which preceded its occurrence.

"27. The rotation of the seasons is a chief element in the vis medicatrix naturæ.

"28. The change of seasons is the safeguard of the human race.

"29. The daily habits of mankind are based upon the beneficial effects of change of season.

"30. The beneficial action of the rotation of the seasons is the true foundation of expectant methods of medical treatment, and therefore of homœopathy.

"31. The kind of cases which are said to be especially fitted for homœopathy are those in which seasonal changes will necessarily lead to improvement of health.

"32. The period when there is the most evident effect from the expectant treatment is at the change of seasons.

"33. The result of treatment in acute diseases varies with the period of the year.

"34. The effect of remedies varies with the different periods of the year.

"35. The action of a remedy will appear to be very different as it acts with or against the natural tendency of the system at the period of its administration."

Chapters 7, 8, and 9 treat at considerable length of the cyclical changes in the infantile, adult, and senile ages of man, and the practical applications of a thorough acquaintance with these changes.

Finally, the cycle of the generations of man is ably discussed in chapters 10, 11, and 12, wherein the reader will find many interesting statements concerning the occurrence and the causes of epidemics and the changes in the social habits and in the type of disease in the nineteenth century.

We have thus presented our readers with a general analytical *résumé* of this most interesting work. At once philosophical in conception and practical in application, the physiologist and the physician will alike find in it many valuable additions to the record of their favourite science, some of which seem to be well established, while others, though highly plausible, need yet a more elaborate investigation before they can be received into the category of undoubted facts.

The work of Dr. Mussey has been undertaken and executed with a different object. It addresses itself to the popular rather than the scientific reader. It has been the author's aim "to meet the comprehension of the general reader, and, at the same time, to present some suggestions which, it is hoped, the young physician may find not wholly beneath his regard."

The work is divided into twenty-five chapters. The first treats of the corset, clothing, boots and shoes, &c., and is illustrated with a series of wood-engravings representing the various quaint styles of dress of former epochs. The second discusses ventilation, light, sleep, exercise, and bathing. Chapters three, four, and five are devoted to the consideration of the uses and effects of alcohol, tobacco, tea, and coffee. Chapter six contains a brief account of the case of the celebrated Casper Hauser. The "organic sympathies" constitute the subject-matter of the next chapter. Throughout the remainder of the work the author eulogizes vegetarianism, labours to show that man is, by nature, a vegetable feeder, and points out, at some length, the ill effects of the omnivorous practices of the human family, and the beneficial results of a vegetable diet in the treatment of various medical and surgical maladies. Finally, an attempt is made to show, in the last chapter, that a purely vegetable regimen favours great length of life.

Many cases of extraordinary longevity are cited in proof of this proposition. There were in the United States, in 1850, two thousand five hundred and fifty-five persons of over one hundred years. This shows, Dr. Mussey thinks, that about one person in nine thousand will be likely to live to that age.

"We have not the means," he writes, "of determining to what extent human life might be carried under the most favourable circumstances. After making due allowance for inaccuracy of record, there is reason for believing that in modern times some few individuals may have attained the age of nearly if not quite two hundred years. It will be recollected that several hundred years were occupied in abridging life—from the time of the flood to the time of Moses, who mentions seventy years as the ordinary period; and if, during this long term, the mischievous influences were gradually deepening their hold on life, until its minimum, in a particular climate and community, had been arrived at, might not, on the other hand, most valuable results be looked for under the operation of hygienic agencies which are within the reach of human ingenuity and effort, protracted through a series of generations? Among these agencies, are, an atmosphere of the highest attainable approach to purity in dwelling-houses and public institutions; the life-quickening power of direct sunshine; much exercise abroad in the open air; clothing adapted to the changes of weather; food nutritious, at the same time bland and unirritating; a drink made in Paradise, made right at first, neither requiring nor admitting of narcotic or alcoholic admixtures, and a medication to extinguish disease, or abate its force, or prevent its attack. We already possess vaccination, which can rid the world of one of the most terrific and destructive epidemics which have invaded the human family; we have the Peruvian bark and its extracts, which operate not only to extinguish marsh and lake fevers, but, when taken at suitable intervals in a malarious atmosphere, neutralize the poison, and are a complete prophylactic or preventive of an attack of the fever; we have mercury and iodide of potassium to meet the poison and allay the tortures of constitutional syphilis; colchicum for the merciless attacks of gout and rheumatism; and carbonate of iron and arsenic and strychnia for some refractory forms of neuralgia. We have already remedies for many parasitic animals and plants that nestle in our internal organs, or burrow or take root in the skin; and as the researches of pathologists are now pushed with enthusiasm in this department, we may anticipate for man a nearer approach to immunity from their attacks upon comfort and life than can ever be realized by the larger animals of the lower tribes which have no means of destroying these invaders, while in self-made diseases, we outnumber them a hundred to one.

"The remedial means we already possess of abating the force of sweeping diseases, or of extinguishing them altogether, reasonably inspire the hope that choleras, yellow fever, scarlatina, typhoid and typhus, and tubercle, if not starved out by hygienic influences, will have their remedies or antidotes, and will be met with the same confidence as we now meet smallpox or lake fever. And if the time shall ever come—and who does not look for a *moral* and *physical* regeneration of our race, for surely one cannot come without the other—when the food best suited to a prolonged and uniform health shall be adopted—the appetite not left to become gluttonous like that of the beasts, but kept under the conscientious control of reason and science—and the only drink that of Paradise, then there will be a progressive improvement in health, and life will be lengthened as certainly as it has been shortened by the sottish inventions of man, the human face no longer blotched and scarred from an empoisoned blood, but fresh and fair, and lit up by an eye sparkling in its hundredth year. On this subject we are not left without a cheering note from the harp of prophecy: 'There shall be no more thence an infant of days, nor an old man that hath not filled his days; for the child shall die an hundred years old; . . . . and they shall build houses and inhabit them; and they shall plant vineyards, and eat the fruit of them. They shall not build, and another inhabit; they shall not plant, and another eat; for as the days of a tree are the days of my people, and mine elect shall long enjoy the work of their hands.'"

Although compelled, in view of the present teachings of physiological science, to dissent from many of the leading views of Dr. Mussey, we do not hesitate to refer the non-professional reader to his work as one in which will be found an extensive and valuable fund of hygienic information.

J. A. M.